Ground and Aircraft Measurements of Hydroperoxides During the MILAGRO Field Campaign

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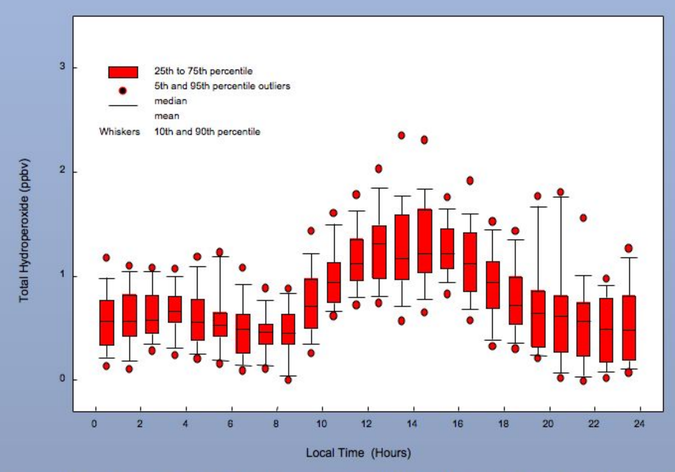
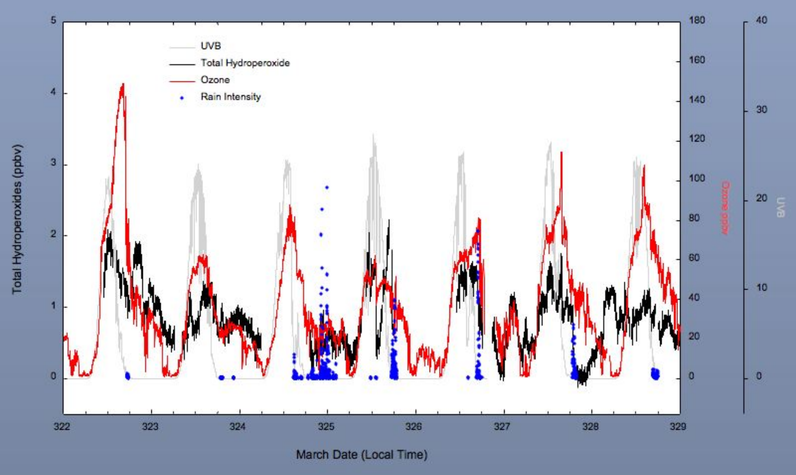
Ground

Measurements of hydroperoxides were conducted aboard the G-1 research aircraft and at the T1 surface site. Soluble peroxides were collected in glass coil scrubbers and analyzed using a continuous-flow fluorometric technique.

Total hydroperoxide time response = 2 minutes DL = 0.20 ppbv

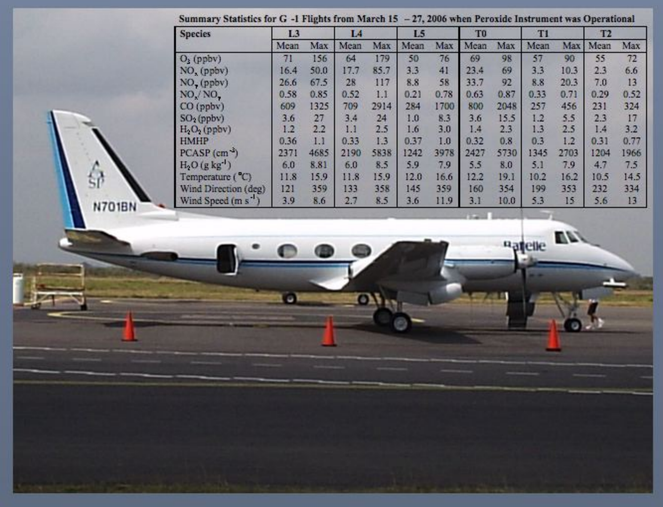


Composite diurnal profile of total hydroperoxide for the period March 12th - 30th.



Time series of total hydroperoxide, ozone, and UVB for the period March 22nd - 29th. Blue symbols indicate rain events.

Comparison of total hydroperoxide concentrations at the T1 surface site with H_2O_2 concentrations for G-1 fly overs during the entire campaign.

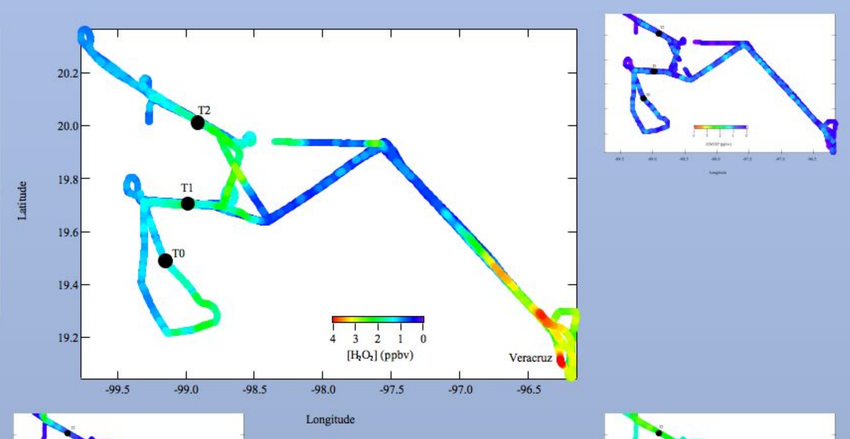


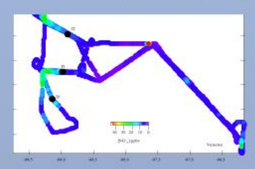
Summary Statistics for G -1 Flights from March 15 – 27, 2006 when Peroxide Instrument was Operational

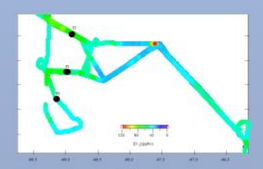
Species	L3		L4		L5		T0		T1		T2	
	Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max
O_3 (ppbv)	71	156	64	179	50	76	69	98	57	90	55	72
NO_x (ppbv)	16.4	50.0	17.7	85.7	3.3	41	23.4	69	3.3	10.3	2.3	6.6
NO_y (ppbv)	26.6	67.5	28	117	8.8	58	33.7	92	8.8	20.3	7.0	13
NO_x/NO_y	0.58	0.85	0.52	1.1	0.21	0.78	0.63	0.87	0.33	0.71	0.29	0.52
CO (ppbv)	609	1325	709	2914	284	1700	800	2048	257	456	231	324
SO_2 (ppbv)	3.6	27	3.4	24	1.0	8.3	3.6	15.5	1.2	5.5	2.3	17
H_2O_2 (ppbv)	1.2	2.2	1.1	2.5	1.6	3.0	1.4	2.3	1.3	2.5	1.4	3.2
HMHP	0.36	1.1	0.33	1.3	0.37	1.0	0.32	0.8	0.3	1.2	0.31	0.77
PCASP (cm^{-3})	2371	4685	2190	5838	1242	3978	2427	5730	1345	2703	1204	1966
H_2O ($g\ kg^{-1}$)	6.0	8.81	6.0	8.5	5.9	7.9	5.5	8.0	5.1	7.9	4.7	7.5
Temperature (°C)	11.8	15.9	11.8	15.9	12.0	16.6	12.2	19.1	10.2	16.2	10.5	14.5
Wind Direction (deg)	121	359	133	358	145	359	160	354	199	353	232	334
Wind Speed ($m\ s^{-1}$)	3.9	8.6	2.7	8.5	3.6	11.9	3.1	10.0	5.3	15	5.6	13

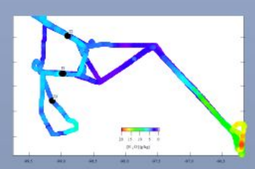
Aircraft

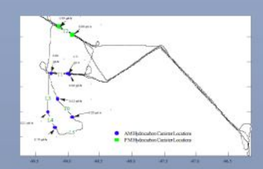
Hydrogen peroxide time response = 40 s DL = 0.25 ppbv
Hydroxymethyl hydroperoxide time response = 40 s DL = 0.35 ppbv



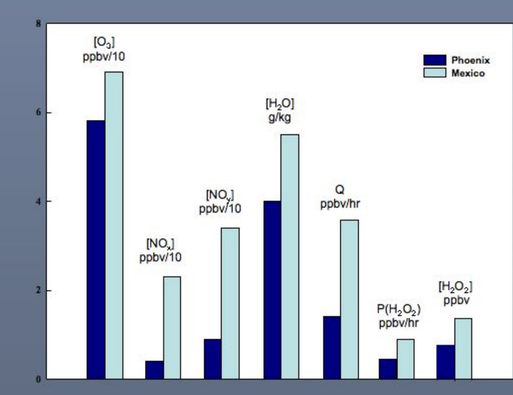








Combined morning and afternoon flight tracks conducted on March 19, 2006; trace gas concentrations are indicated by the color coding on each flight track. Southerly winds transported pollutants from Mexico City to the T1 and T2 sites.



Comparison of average trace gas concentrations and calculated radical and peroxide production rates over the source regions of Phoenix (1998) and Mexico City (2006).

Preliminary Findings

- Hydroperoxide mixing ratios in Mexico City were relatively low. Although models predicted concentrations near 50 ppbv, we observed a maximum of 2.2 ppbv on G-1 flights around the source region, and peak concentrations below 2.0 ppbv during the afternoon at the T1 site.
- During G-1 flights, we observed relatively high peroxide concentrations (up to 5.8 ppbv) in a layer between 500 and 1500 m near Veracruz, where temperature and water vapor concentrations were much higher than in Mexico City.
- Hydroxymethyl hydroperoxide concentrations were mostly at the detection limit (~0.30 ppbv).
- We observed local production of hydroperoxide at the T1 surface site, with peak values generally occurring near 14:00 local time.
- Plumes of peroxide and O_3, frequently observed after midnight at T1, indicated transport of photochemical products from the source region.
- Total peroxide at the T1 surface site agreed well with H_2O_2 on G-1 fly overs.
- Mean ozone and water vapor concentrations in the source region were similar to those we observed in Phoenix in Spring 1998. The mean H_2O_2 production rate in the Mexico City source region was 0.09 ppbv/hour, twice that observed in Phoenix. The relatively low production rate of peroxide can be attributed to high NO_x.

Acknowledgements

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